

CLAIMS

1. A tracking error signal generating apparatus for generating a tracking error signal for tracking control which allows a light beam to follow a track on a recording surface of a recording medium,

said tracking error signal generating apparatus comprising:

a detecting device, which has four light receiving units divided by a first dividing line extending in a direction corresponding to a direction of crossing the track and a second dividing line extending in a direction corresponding to a direction along the track, for receiving reflected light of the light beam from the recording surface with the four light receiving units and for outputting detection signals corresponding to the reflected light received by the respective light receiving units;

an adding device for adding the detection signals outputted from a first light receiving unit and a second light receiving unit, located on one side of a boundary made by the first dividing line, out of the four light receiving units and for outputting a result of the addition as an added signal;

a first phase comparing device for outputting a first phase difference signal which indicates a phase difference between the detection signal outputted from the first light receiving unit and the added signal;

a second phase comparing device for outputting a second phase difference signal which indicates a phase difference between the detection signal outputted from the second light receiving unit and the added signal; and

a subtracting device for subtracting the second phase difference signal from the first phase difference signal.

2. The tracking error signal generating apparatus according to claim 1, wherein

said first phase comparing device has a first signal converting device
5 for generating a signal with an amplitude corresponding to the phase difference between the detection signal outputted from the first light receiving unit and the added signal and for outputting this generated signal as the first phase difference signal, and

said second phase comparing device has a second signal converting
10 device for generating a signal with an amplitude corresponding to the phase difference between the detection signal outputted from the second light receiving unit and the added signal and for outputting this generated signal as the second phase difference signal.

15 3. A tracking error signal generating method of generating a tracking error signal for tracking control which allows a light beam to follow a track on a recording surface of a recording medium,

said tracking error signal generating method comprising:

a light detecting process of receiving, by using a detecting device
20 which has four light receiving units divided by a first dividing line extending in a direction corresponding to a direction of crossing the track and a second dividing line extending in a direction corresponding to a direction along the track, reflected light of the light beam from the recording surface with the four light receiving units and of outputting detection signals corresponding to
25 the reflected light received by the respective light receiving units;

an adding process of adding the detection signals outputted from a

first light receiving unit and a second light receiving unit, located on one side of a boundary made by the first dividing line, out of the four light receiving units and of outputting a result of the addition as an added signal;

5 a first phase comparing process of outputting a first phase difference signal which indicates a phase difference between the detection signal outputted from the first light receiving unit and the added signal;

a second phase comparing process of outputting a second phase difference signal which indicates a phase difference between the detection signal outputted from the second light receiving unit and the added signal;

10 and

a subtracting process of subtracting the second phase difference signal from the first phase difference signal.

4. A tracking error signal generating apparatus for generating a
15 tracking error signal for tracking control which allows a light beam to follow a track on a recording surface of a recording medium,

said tracking error signal generating apparatus comprising:

20 a detecting device, which has four light receiving units divided by a first dividing line extending in a direction corresponding to a direction of crossing the track and a second dividing line extending in a direction corresponding to a direction along the track, for receiving reflected light of the light beam from the recording surface with the four light receiving units and for outputting detection signals corresponding to the reflected light received by the respective light receiving units;

25 a first adding device for adding the detection signals outputted from a first light receiving unit and a second light receiving unit, located on one side

of a boundary made by the first dividing line, out of the four light receiving units and for outputting a result of the addition as a first added signal;

5 a second adding device for adding the detection signals outputted from a third light receiving unit and a fourth light receiving unit, located on the other side of the boundary made by the first dividing line, out of the four light receiving units and for outputting a result of the addition as a second added signal;

10 a first phase comparing device for outputting a first phase difference signal which indicates a phase difference between the detection signal outputted from the first light receiving unit and the first added signal;

a second phase comparing device for outputting a second phase difference signal which indicates a phase difference between the detection signal outputted from the third light receiving unit diagonally adjacent to the first light receiving unit and the second added signal; and

15 a third adding device for adding the first phase difference signal and the second phase difference signal to each other.

5. The tracking error signal generating apparatus according to claim 4, wherein

20 said first phase comparing device has a first signal converting device for generating a signal with an amplitude corresponding to the phase difference between the detection signal outputted from the first light receiving unit and the first added signal and for outputting this generated signal as the first phase difference signal, and

25 said second phase comparing device has a second signal converting device for generating a signal with an amplitude corresponding to the phase

difference between the detection signal outputted from the third light receiving unit and the second added signal and for outputting this generated signal as the second phase difference signal.

- 5 6. The tracking error signal generating apparatus according to claim 4, further comprising:

 a third phase comparing device for outputting a third phase difference signal which indicates a phase difference between the detection signal outputted from the second light receiving unit and the first added signal;

- 10 a fourth phase comparing device for outputting a fourth phase difference signal which indicates a phase difference between the detection signal outputted from the fourth light receiving unit diagonally adjacent to the second light receiving unit and the second added signal;

- a fourth adding device for adding the third phase difference signal
15 and the fourth phase difference signal to each other; and

 a subtracting device for subtracting a fourth added signal which indicates a result of the addition by said fourth adding device from a third added signal which indicates a result of the addition by said third adding device.

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7. The tracking error signal generating apparatus according to claim 6, wherein

- said third phase comparing device has a third signal converting device for generating a signal with an amplitude corresponding to the phase
25 difference between the detection signal outputted from the second light receiving unit and the first added signal and for outputting this generated

signal as the third phase difference signal, and

said fourth phase comparing device has a fourth signal converting device for generating a signal with an amplitude corresponding to the phase difference between the detection signal outputted from the fourth light receiving unit and the second added signal and for outputting this generated signal as the fourth phase difference signal.

8. A tracking error signal generating method of generating a tracking error signal for tracking control which allows a light beam to follow a track on a recording surface of a recording medium,

said tracking error signal generating method comprising:

a light detecting process of receiving, by using a detecting device which has four light receiving units divided by a first dividing line extending in a direction corresponding to a direction of crossing the track and a second dividing line extending in a direction corresponding to a direction along the track, reflected light of the light beam from the recording surface with the four light receiving units and for outputting detection signals corresponding to the reflected light received by the respective light receiving units;

a first adding process of adding the detection signals outputted from a first light receiving unit and a second light receiving unit, located on one side of a boundary made by the first dividing line, out of the four light receiving units and for outputting a result of the addition as a first added signal;

a second adding process of adding the detection signals outputted from a third light receiving unit and a fourth light receiving unit, located on the other side of the boundary made by the first dividing line, out of the four light receiving units and for outputting a result of the addition as a second

added signal;

a first phase comparing process of outputting a first phase difference signal which indicates a phase difference between the detection signal outputted from the first light receiving unit and the first added signal;

5 a second phase comparing process of outputting a second phase difference signal which indicates a phase difference between the detection signal outputted from the third light receiving unit diagonally adjacent to the first light receiving unit and the second added signal; and

a third adding process of adding the first phase difference signal and
10 the second phase difference signal to each other.

9. The tracking error signal generating method according to claim 8, further comprising:

a third phase comparing process of outputting a third phase
15 difference signal which indicates a phase difference between the detection signal outputted from the second light receiving unit and the first added signal;

a fourth phase comparing process of outputting a fourth phase difference signal which indicates a phase difference between the detection
20 signal outputted from the fourth light receiving unit diagonally adjacent to the second light receiving unit and the second added signal;

a fourth adding process of adding the third phase difference signal and the fourth phase difference signal to each other; and

a subtracting process of subtracting a fourth added signal which
25 indicates a result of the addition by said fourth adding device, from a third added signal which indicates a result of the addition by said third adding

device.